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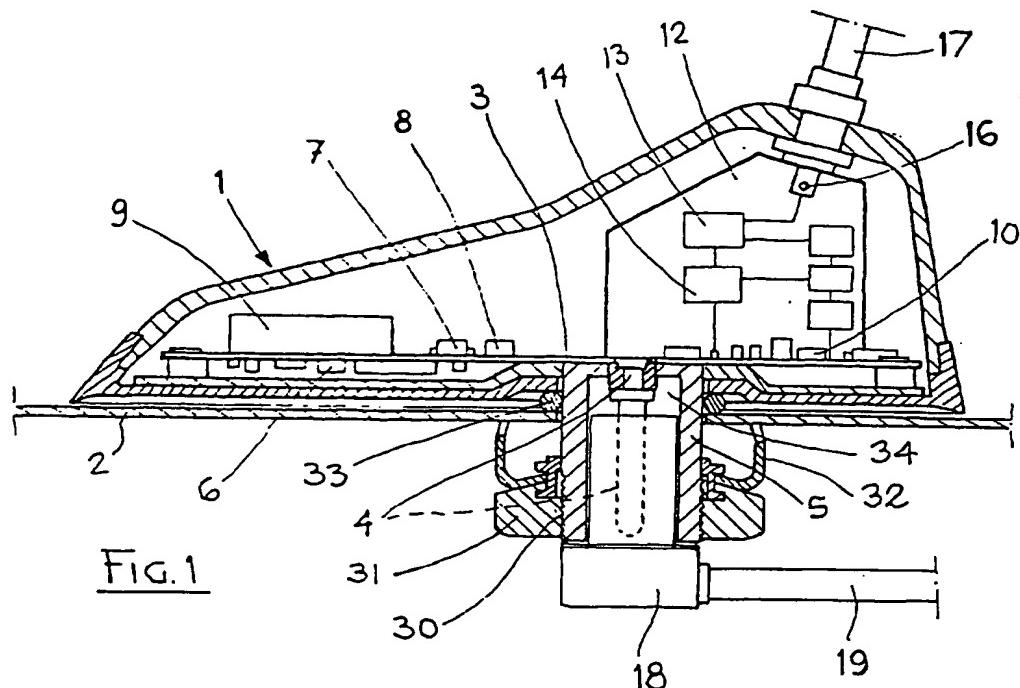
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(54) Roof-mounted multifunctional car antenna

(57) A multifunction antenna particularly suited for the roof panel of cars characterised by the fact that in the container (1) the following functions are comprised the radio reception function in AM and FM bands (10), the GPS (Global Positioning System) signal reception function (6) of reception/transmission of GSM (Global System for Mobile Communications)/DCS Dual Band (12) telephone signals and the mixing functions of vari-

ous signals and of the required feedings on a unique coaxial connector (4); the multifunction antenna being interfaced to an ITN (Info-Telematic Node) system at the entry (20) of which a signal demixer (21) is placed, said signal demixer is interconnected to said coaxial connector (4) through a unique screened coaxial cable (19) through which all the mixed signals and the properly measured feedings are transmitted and/or received.



Description

[0001] The present invention refers to a multifunction antenna. More particularly, the present invention refers to a multifunction antenna which is generally suited to be installed on the roof panel of cars.

[0002] It is well known that the multifunction reception and transmission systems of radio and telephone signals which are presently adopted for the installation on cars are created according to various realizations. Some of them adopt separate and different antennas and connections for each function which cannot interfere among them in any way. In other realizations some functions are associated and, in this case, they require particular screening stratagems in order to avoid interferences among the same functions.

[0003] The realizations of the first type are the more reliable ones, but they are more easily installed only on luxury cars, where problems connected to the spaces required to place the systems and the production cost containment requirements are marginal.

[0004] In the most common and recent multifunction systems which are greatly installed on intermediate and small cars and where a particular attention must be paid on possible production cost savings and installation times of the systems, the antennas and their electronic circuits tend to be comprised in a unique container which can be applied on the roof panel of cars.

[0005] Said antennas are connected to the so-called "Info-Telematic Nodes" (ITN), placed in the dashboard which, in their simplest form, comprise separate entries for each function.

[0006] The most common and required realizations of multifunction systems are the ones comprising a reception antenna of the amplitude modulation (AM) and the frequency modulation (FM) radio signals together with its relevant feeding; a reception/transmission antenna of Dual Band telephony signals; a reception antenna of the GPS signals for navigation and a corresponding power supply.

[0007] These realizations are generally connected to the separate entries of the various functions which are placed on said ITNs through single and independent cables.

[0008] In more advanced applications the reception function of the AM and FM radio signals and the reception/transmission function of the Dual Band telephony signals are obtained by the same rod; while the reception of GPS navigation signals is obtained by a miniaturized patch antenna. Moreover, the feedings reach the amplification and matching circuits both for the AM/FM reception part and for the one receiving the GPS signals through the central wire of the respective output coaxial cables.

[0009] The research is substantially aimed at finding economical solutions being able to face the business competition aggressiveness. All the above mentioned solutions are conceived in order to reduce the number

of applied cables, their extension and the related connections, simplify the coupling means of connections, reduce the costs of the single components and times related to application, installation and maintenance interventions, the labour and the costs in general considering the technological requirements of the systems which are due to correctly operate without interference problems among the various functions.

[0010] To this purpose, in some of the most recent configurations the reception/transmission of Dual Band telephony signals associated to the AM and FM radio signal reception antenna rod comprises a unique coaxial cable for the connection to the ITN system which also conveys the power supply to the relevant electronic circuits, while for the reception signals of the GPS navigation systems where the risk of interferences towards other functions is very high, the connection among the antenna, the ITN system itself and the relevant feeding requires a separate coaxial cable.

[0011] Object of the present invention is to overcome also this inconvenient. The invention as it is, characterised by the claims, solves the problem through a multifunction roof panel antenna for cars which is comprised in a unique container including: the radio reception function in AM and FM bands, the reception/transmission function of the GSM (Global System for Mobile Communications) Dual Band (900 an 1800 MHz bands) telephone signals, the reception function of the GPS (Global Positioning System) signal and a signal mixer of these functions; the latter interfacing with an ITN (Info-Telematic Node) equipped with a suitable demixer by a unique screened coaxial cable through which the signals of all the above mentioned functions and the required feedings are properly measured, transmitted and/or received.

[0012] The advantages obtained according to the present invention essentially consist in the fact that the container which can be applied to the roof panel of cars includes all the antennas with the relevant feeding, reception, reception/transmission electronic circuits which associate to a unique mixing circuit of the signals of the various functions. Said mixer depends on a unique quick coupling output connector for a unique coaxial cable to be connected to an ITN unit placed in the dashboard; the ITN unit is equipped with one entry connector for a demixer fit for the separation of the signals of the various functions.

[0013] Everything is configured in such a way to adopt only one coaxial cable having a limited extent to be reduced to one connection only among antennas and ITNs, in order to simplify the coupling means of connections and greatly reduce the costs related to single components, labour and installation times thus keeping the technical features of the systems operating without interferences among the various functions unchanged.

[0014] The invention is described in detail here below according to one embodiment which is exclusively given by way of illustrative but non-limitative example, with ref-

erence to the following drawings wherein:

Figure 1 represents the schematised longitudinal section of a roof panel container comprising: the various antennas, the relevant signal amplification and/or impedance matching electronic circuits, the signal mixing circuit, the feedings of the various functions and the unique connector for the output coaxial cable,

Figure 2 represents a non-limitative example of the scheme of the amplification electronic circuit of the AM-FM reception antenna,

Figure 3 represents a non-limitative example of the impedance matching and filtering electronic circuit for the Dual Band reception/transmission telephone antenna (900 MHz - GSM and 1800 MHz - DCS), Figure 4 represents a non-limitative example of the scheme of the electronic circuit of the GPS navigation antenna,

Figure 5 represents the block diagram of the electronic circuits of the whole antenna and of the signal mixing circuit and,

Figure 6 represents the block diagram of the signal demixing electronic circuit which is placed at the entry of the ITN unit.

[0015] With reference to Figure 1, inside a container 1 which can be applied to the roof panel 2 of cars, a first horizontal board 3 is placed on which, from printed circuit, a coaxial connector 4 getting into constraint and contact relation with a fixing hub 5 is integral.

[0016] On the lower front part of the horizontal board 3 the low noise amplification (LNA) electronic circuit for GPS signals together with a narrow band band-pass filter 7 is obtained. On the upper front part of the same horizontal board 3 the "patch antenna" 9 related to the same electronic circuit 6 of the GPS function is placed. In the rear part of the horizontal board 3, the electronic circuit 10 of the AM/FM radio receiving functions with the low-pass filter 11 and the connection to a vertical board 12 on which the impedance matching circuit 13 with the matching high-pass filter 14 for the Dual Band (GSM/DCS) telephony reception/transmission function and the contact with the cap 16 of the antenna rod 17 which is common for both functions is placed.

[0017] In Figures 2,3 and 4 examples of various antenna circuits are represented: the circuit 10 for AM/FM radio reception which is placed on the rear part of the horizontal board 3; the circuit 13 for the reception/transmission of Dual Band telephony which is placed on the vertical board 12; the circuit 6 for the GPS navigation reception which is placed on the front part of the same horizontal board 3.

[0018] Figure 5 represents the whole block diagram of the above-mentioned circuits wherein the power supply point for the electronic circuit 10 of AM/FM radio reception is marked with the "a" symbol. Said reception is obtained by the block inductance "c" directly from the

central wire of the unique output coaxial cable and it is connected to the GPS navigation electronic circuit 6 (in order to reduce the feeding voltage from 10-16 V to the required 3 or 5 V) through the voltage regulator 8.

5 [0019] In the block diagram represented in Figure 5, the multifunction rod 17 is connected to the impedance matching circuit 13 and subsequently to the high - pass filter 14 through the node 16. The multifunction rod itself is also connected to the two separate stages for the AM signal conditioning and the matching and/or the amplification of the FM signals. At their turn, the signals of the two stages sum up and pass through the low - pass filter 11. The receiving element for the signals of the GPS 9 (which is generally a patch antenna with a circular polarization) is connected to the low noise amplification electronic circuit 6 which, in its turn, is connected to the band - pass filter 7. The signals going out from the three filters 14, 11 and 7 gather together in 4 and, through the connector 18, they go to the unique coaxial cable 19 and to the signal demixing electronic circuit 21.

10 [0020] The current feeding for all the active circuits of the multifunction antenna which are present on the central wire of the coaxial cable 19 crosses the low - pass filter 11 and it is separated by the signal wires through the choke C and the balancing capacitor connected to it. From here, it directly feeds the AM and FM stages and also the low noise amplification electronic circuit 6 through the voltage regulator 8.

15 [0021] The A (870+960 MHz); B (1710+1880 MHz) GSM7DCS Dual Band telephony; C (1575± 5 MHz) GPS navigation system; D (0-110 MHz) AM/FM radio reception and the required feedings filtered antenna signals are conveyed and mixed on the unique coaxial connector 4 which is associated to the fixing hub 5 which,

20 30 25 35 40 45 50 55 [0021] The A (870+960 MHz); B (1710+1880 MHz) GSM7DCS Dual Band telephony; C (1575± 5 MHz) GPS navigation system; D (0-110 MHz) AM/FM radio reception and the required feedings filtered antenna signals are conveyed and mixed on the unique coaxial connector 4 which is associated to the fixing hub 5 which, through its lower threaded part 30 coupled to a nut 31 with a grip elastic element 32 and a gasket 33, acts as a constraint element of the multifunction antenna to the roof panel 2, while with its hollow central part 34 it constitutes the guiding and contact element for the same connector 4. A complementary plug applied to one end of a short cable with pigtail connector to which a further coaxial cable connects can be engaged to the connector 4; a plug 18 for a unique specific coaxial cable 19 can be also engaged to the connector 4 for each type of car on which the multifunction antenna is applied. Such unique specific coaxial cable 19 develops for a sufficient and right length allowing the connection with the unique connector 20 of a signal demixing electronic circuit 21 placed at the entry of the Info-Telematic Node (ITN)

60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 1235 1240 1245 1250 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5255 5260 5265 5270 5275 5280 5285 5290 5295 5300 5305 5310 5315 5320 5325 5330 5335 5340 5345 5350 5355 5360 5365 5370 5375 5380 5385 5390 5395 5400 5405 5410 5415 5420 5425 5430 5435 5440 5445 5450 5455 5460 5465 5470 5475 5480 5485 5490 5495 5500 5505 5510 5515 5520 5525 5530 5535 5540 5545 5550 5555 5560 5565 5570 5575 5580 5585 5590 5595 5600 5605 5610 5615 5620 5625 5630 5635 5640 5645 5650 5655 5660 5665 5670 5675 5680 5685 5690 5695 5700 5705 5710 5715 5720 5725 5730 5735 5740 5745 5750 5755 5760 5765 5770 5775 5780 5785 5790 5795 5800 5805 5810 5815 5820 5825 5830 5835 5840 5845 5850 5855 5860 5865 5870 5875 5880 5885 5890 5895 5900 5905 5910 5915 5920 5925 5930 5935 5940 5945 5950 5955 5960 5965 5970 5975 5980 5985 5990 5995 6000 6005 6010 6015 6020 6025 6030 6035 6040 6045 6050 6055 6060 6065 6070 6075 6080 6085 6090 6095 6100 6105 6110 6115 6120 6125 6130 6135 6140 6145 6150 6155 6160 6165 6170 6175 6180 6185 6190 6195 6200 6205 6210 6215 6220 6225 6230 6235 6240 6245 6250 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7255 7260 7265 7270 7275 7280 7285 7290 7295 7300 7305 7310 7315 7320 7325 7330 7335 7340 7345 7350 7355 7360 7365 7370 7375 7380 7385 7390 7395 7400 7405 7410 7415 7420 7425 7430 7435 7440 7445 7450 7455 7460 7465 7470 7475 7480 7485 7490 7495 7500 7505 7510 7515 7520 7525 7530 7535 7540 7545 7550 7555 7560 7565 7570 7575 7580 7585 7590 7595 7600 7605 7610 7615 7620 7625 7630 7635 7640 7645 7650 7655 7660 7665 7670 7675 7680 7685 7690 7695 7700 7705 7710 7715 7720 7725 7730 7735 7740 7745 7750 7755 7760 7765 7770 7775 7780 7785 7790 7795 7800 7805 7810 7815 7820 7825 7830 7835 7840 7845 7850 7855 7860 7865 7870 7875 7880 7885 7890 7895 7900 7905 7910 7915 7920 7925 7930 7935 7940 7945 7950 7955 7960 7965 7970 7975 7980 7985 7990 7995 8000 8005 8010 8015 8020 8025 8030 8035 8040 8045 8050 8055 8060 8065 8070 8075 8080 8085 8090 8095 8100 8105 8110 8115 8120 8125 8130 8135 8140 8145 8150 8155 8160 8165 8170 8175 8180 8185 8190 8195 8200 8205 8210 8215 8220 8225 8230 8235 8240 8245 8250 8255 8260 8265 8270 8275 8280 8285 8290 8295 8300 8305 8310 8315 8320 8325 8330 8335 8340 8345 8350 8355 8360 8365 8370 8375 8380 8385 8390 8395 8400 8405 8410 8415 8420 8425 8430 8435 8440 8445 8450 8455 8460 8465 8470 8475 8480 8485 8490 8495 8500 8505 8510 8515 8520 8525 8530 8535 8540 8545 8550 8555 8560 8565 8570 8575 8580 8585 8590 8595 8600 8605 8610 8615 8620 8625 8630 8635 8640 8645 8650 8655 8660 8665 8670 8675 8680 8685 8690 8695 8700 8705 8710 8715 8720 8725 8730 8735 8740 8745 8750 8755 8760 8765 8770 8775 8780 8785 8790 8795 8800 8805 8810 8815 8820 8825 8830 8835 8840 8845 8850 8855 8860 8865 8870 8875 8880 8885 8890 8895 8900 8905 8910 8915 8920 8925 8930 8935 8940 8945 8950 8955 8960 8965 8970 8975 8980 8985 8990 8995 9000 9005 9010 9015 9020 9025 9030 9035 9040 9045 9050 9055 9060 9065 9070 9075 9080 9085 9090 9095 9100 9105 9110 9115 9120 9125 9130 9135 9140 9145 9150 9155 9160 9165 9170 9175 9180 9185 9190 9195 9200 9205 9210 9215 9220 9225 9230 9235 9240 9245 9250 9255 9260 9265 9270 9275 9280 9285 9290 9295 9300 9305 9310 9315 9320 9325 9330 9335 9340 9345 9350 9355 9360 9365 9370 9375 9380 9385 9390 9395 9400 9405 9410 9415 9420 9425 9430 9435 9440 9445 9450 9455 9460 9465 9470 9475 9480 9485 9490 9495 9500 9505 9510 9515 9520 9525 9530 9535 9540 9545 9550 9555 9560 9565 9570 9575 9580 9585 9590 9595 9600 9605 9610 9615 9620 9625

and 70 dB and is obtained by a filter on the GPS path of at least 50 dB and by a notch filter which is placed on the phone side producing an attenuation of at least 10 dB.

[0023] From the confluence node 29 of the mixed signals, signals **A** and/or **B** pass through a high-pass filter 22 and a stop filter 23 at 1575 MHz with an attenuation of at least 10 dB in order to reach the Dual Band telephony transceiver set included in the ITN. Signals **C** pass through a band-pass filter 24 at 1575 MHz with A (attenuation) > 50 dB at 1700 MHz in order to be picked up by the radio receiving set included in the ITN.

[0024] In the schemes of Figures 2 and 3, XX and YY represent the interface points of the electronic circuit 10 of the AM/FM radio reception which is placed on the rear part of the horizontal board 3 and of the impedance matching circuit 13 of the Dual Band telephone transmission/reception which is placed on the vertical board 12 which are associated to the same antenna 17. In the scheme of Figure 2, the power supply point (cf 10-16 V) of the electronic circuit 10 of the AM/FM radio reception is represented with "a", while in the scheme of Figure 4, "a" represents the power supply point equipped with the relevant voltage regulator 8 of the low noise amplification electronic circuit 6 of GPS signals which is placed on the front part of the horizontal board 3 and it is associated to the "patch antenna" 9. In the schemes of Figures 2 and 4 "b" represents the interface point of the electronic circuits 6 and 10 towards the unique coaxial connector 4.

[0025] Even though the present invention has been described and illustrated here with reference to an embodiment which is given only by way of non-limitative example, it is clear that various changes and variants to forms, particulars, components and combinations can be made by people skilled in the art according to the above-mentioned description. It is therefore clear that the present invention is meant to include all the changes and variants falling within the spirit and the protection field of the following claims.

Claims

1. A multifunction antenna particularly suited for the roof panel of cars **characterised by** the fact that in the container (1) the following functions are comprised: the radio reception function in AM and FM bands (10), the GPS (Global Positioning System) signal reception function (6) of reception/transmission of GSM (Global System for Mobile Communications)/DCS Dual Band (12) telephone signals and the mixing functions of various signals and of the required feedings on a unique coaxial connector (4); the multifunction antenna being interfaced to an ITN (Info-Telematic Node) system at the entry (20) of which a signal demixer (21) is placed, said signal demixer is interconnected to said coaxial connector

- 5 (4) through a unique screened coaxial cable (19) through which all the mixed signals and the properly measured feedings are transmitted and/or received.
- 10 2. The multifunction antenna according to claim 1, **characterized by** the fact that, inside the container (1) which can be applied to the roof panel (2) of cars, a first horizontal board (3) on which a coaxial connector (4), from printed circuit is integral in correspondence of a fixing hub (5) for a coaxial connector (19), is placed.
- 15 3. The multifunction antenna according to claim 1 or 2, **characterized by** the fact that on the lower front part of the horizontal board (3) a low noise amplification (LNA) electronic circuit (6) for GPS signals comprising a narrow-band band-pass filter (7) is obtained; on the upper front part of the same horizontal board (3) a "patch antenna" (9) related to the same electronic circuit (6) of said GPS function is placed.
- 20 4. The multifunction antenna according to any of the previous claims, **characterized by** the fact that in the rear part of the horizontal board (3) an electronic circuit (10) of the AM/FM radio reception functions with low-pass filter (11) is placed together with the connection with a vertical board (12) on which an impedance matching circuit (13) with low-pass matching filter (14) for Dual Band telephony reception/transmission function; on said vertical board (12) being placed the contact with the cap (16) of the antenna rod (17) which is common to both functions.
- 25 5. The multifunction antenna according to any of the previous claims, **characterized by** the fact that the **A** (870+960 MHz); **B** (1710+1880 MHz) GSM7DCS Dual Band telephony; **C** (1575± 5 MHz) GPS navigation system; **D** (0-110 MHz) AM/FM radio reception and the required feedings filtered antenna signals are conveyed and mixed on the unique coaxial connector (4).
- 30 6. The multifunction antenna according to any of the previous claims **characterized by** the fact that a complementary plug applied to one end of a short cable with pigtail connector to which a further specific coaxial cable (19) connects whose length is sufficient and right for each type of car on which the multifunction antenna is applied for the connection with the unique connector (20) of a signal demixing electronic circuit (21) placed at the entry of the Info-Telematic Node (ITN) housed in the dashboard can be engaged on the connector (4).
- 35 7. The multifunction antenna according to any of the
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- 45
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previous claims, characterized by the fact that it comprises a plug (18) for a unique specific coaxial cable (19) whose length is right and sufficient for each type of car on which the multifunction antenna is applied for the connection with the unique connector (20) of a signal demixing electronic circuit (21) placed at the entry of the Info-Telematic Node (ITN) housed in the dashboard.

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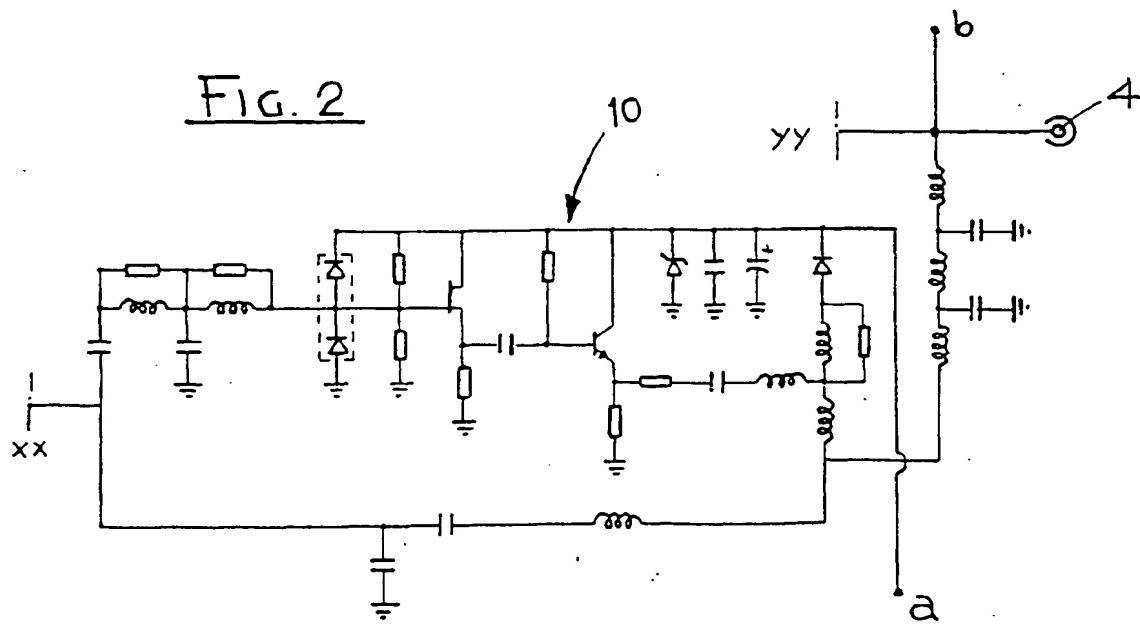
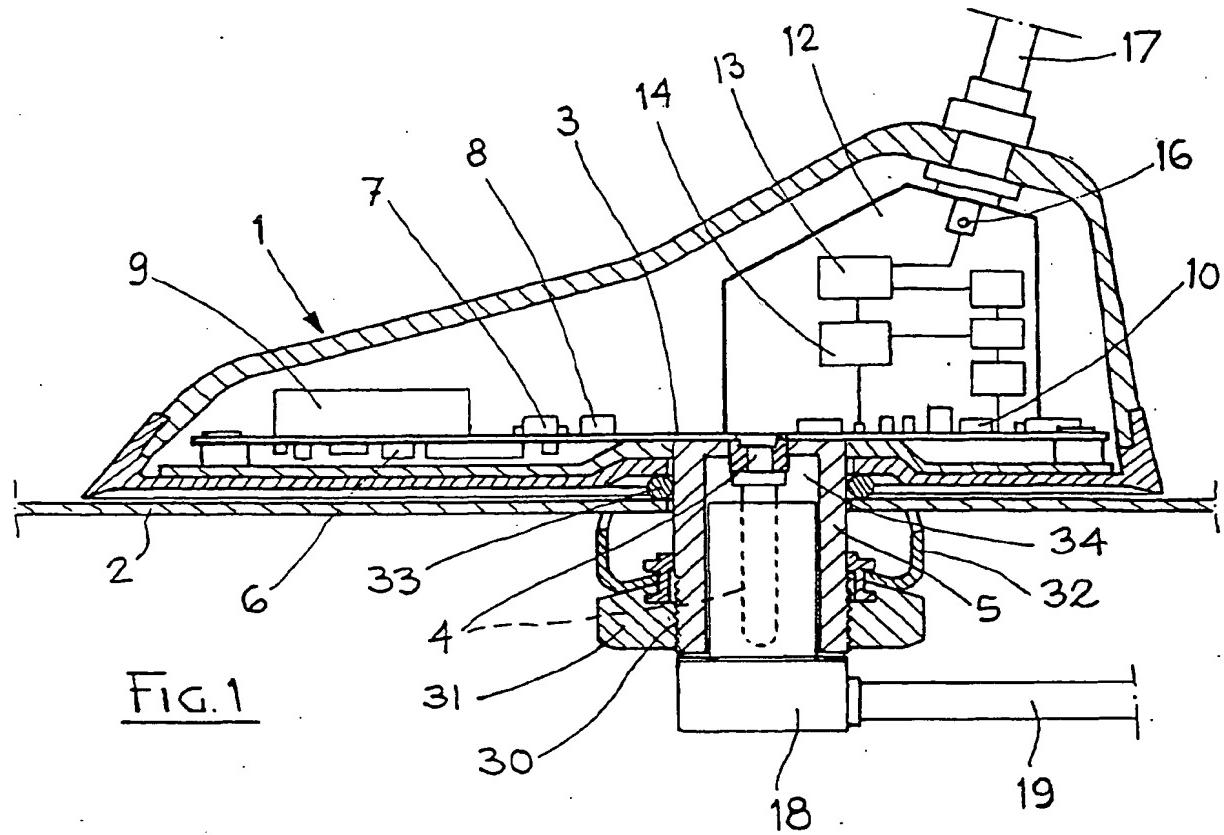
8. The multifunction antenna according to any of the previous claims characterized by the fact that the demixer (21) comprises: a high-pass filter (22) and a stop filter at 1575 MHz (23) with an attenuation of at least 10 dB for the demixing of the A (870+960 MHz) and/or the B (1710+1880 MHz) ingoing/outgoing signals of the Dual Band telephony transceiver set comprised in the ITN; a band-pass filter (24) at 1575 MHz with A>50 dB at 1700 MHz, for the demixing of the C signals (1575±5 MHz) of the GPS navigation system which can be detected from the GPS receiver set comprised in the ITN; a low-pass filter (25) for the demixing of the D (0-110 MHz) signals of the AM/FM radio reception which can be detected from the radio receiving set comprised in the ITN. 10
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9. The multifunction antenna according to any of the previous claims, characterized by the fact that the insulation between DCS and GPS at 1700 MHz of the demixer (21) is comprised between 60 and 70 dB. 30
10. The multifunction antenna according to claim 9 characterized by the fact that the insulation between DCS and GPS is obtained by a filter placed on the GPS path of at least 50 dB and by a notch filter placed on the phone side producing an attenuation of at least 10 dB. 35

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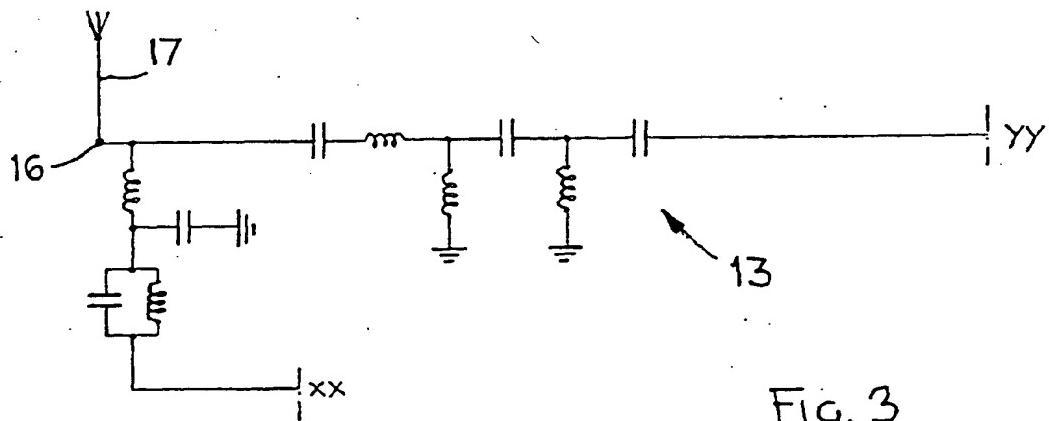


FIG. 3

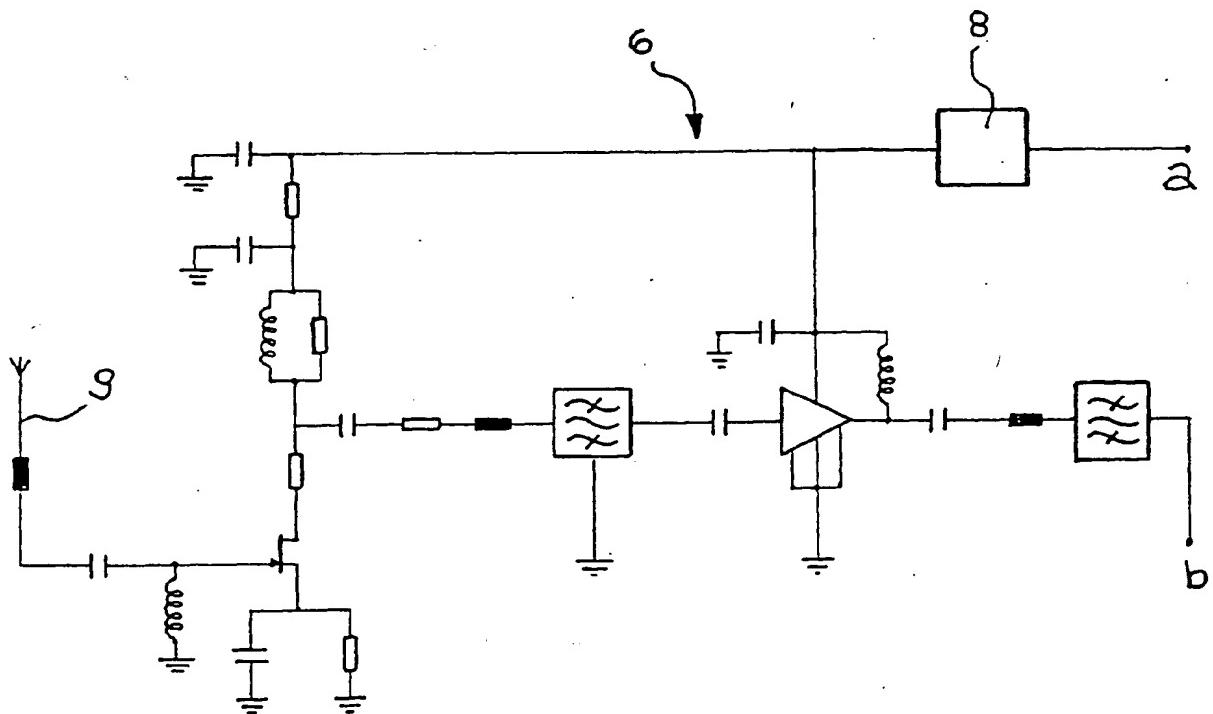


FIG. 4

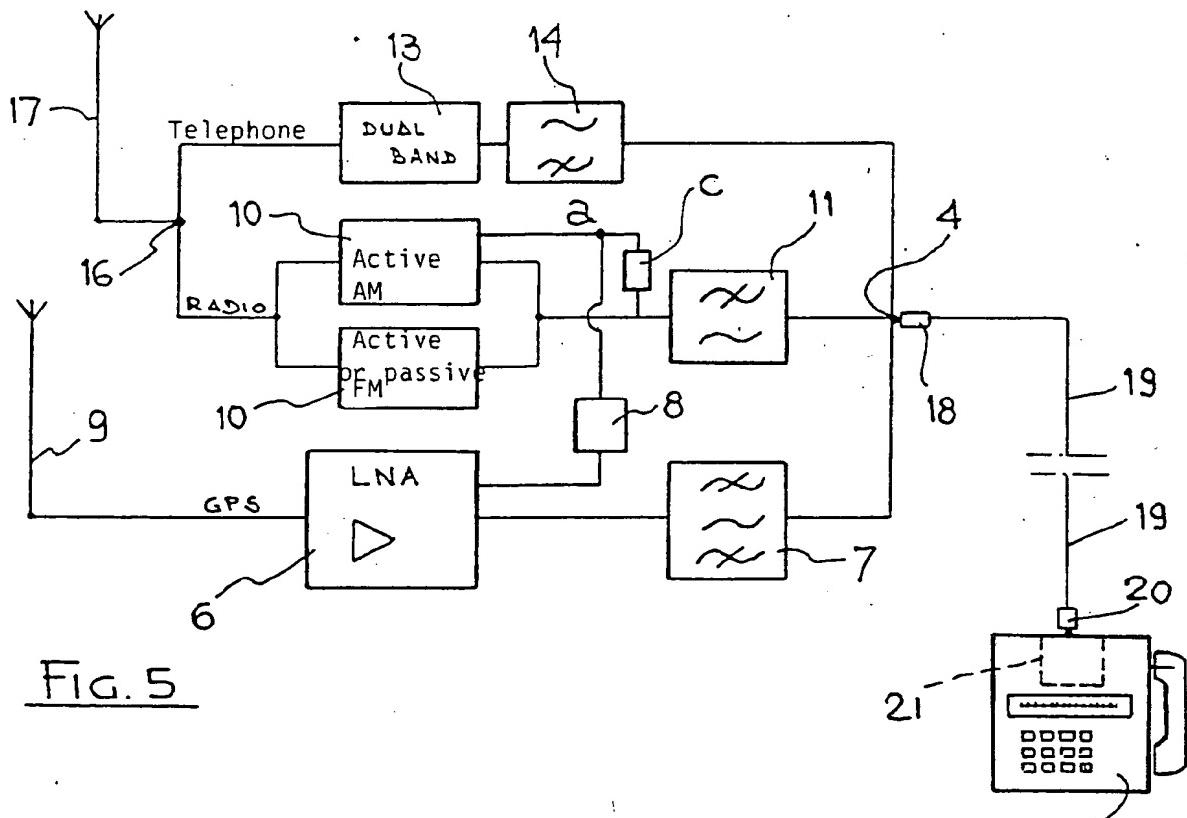


FIG. 5

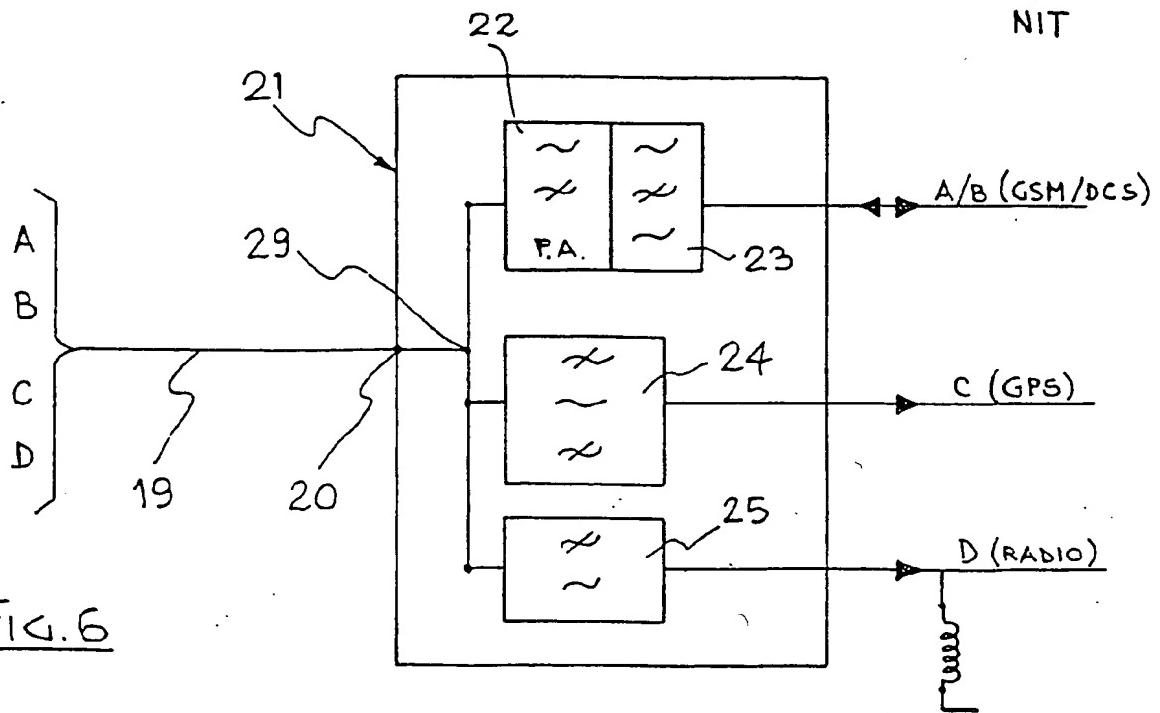


FIG. 6



**European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 02 01 6135

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Place of search	Date of completion of the search	Examiner	
THE HAGUE	21 August 2002	Ribbe, J	
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